

THERMAL HISTORY OF LEWIS CLIFF 85332. H. Kaiden, T. Mikouchi, and M. Miyamoto, Mineralogical Institute, Graduate School of Science, University of Tokyo, Hongo, Tokyo 113, JAPAN (kaiden@min.s.u-tokyo.ac.jp).

Introduction: Lewis Cliff 85332 (LEW 85332) was initially classified as a CO3 chondrite mainly on the basis of the small sizes of its chondrules [1]. It is similar to the CO3 chondrites in several petrologic characteristics, but its bulk refractory lithophile ratios are lower than those of the CO3 chondrites and its common and volatile siderophile ratios are higher [2]. Although the meteorite shows affinity to CI and CR chondrites in its abundance ratios of refractory lithophiles and refractory siderophiles, it has lower abundance ratios of Mn, Se, Zn, and most volatile siderophiles than CI chondrites and higher abundance ratios of Mn and most volatile siderophiles than CR chondrites [2]. From these petrologic and chemical characteristics, LEW 85332 is designated as a unique carbonaceous chondrite [2].

Several petrologic properties suggest that LEW 85332 is a highly unequilibrated chondrite, corresponding to petrologic type 3.0–3.1 [2,3]. Sears et al. [4] have assigned it to type 3.0 on the basis of the very low thermoluminescence (TL) sensitivity, which resembles that of other very primitive CO3 chondrites.

In the present work, we have analyzed chemical zoning of olivines in the LEW 85332 to study the possibility of metamorphism. Both crystallization and metamorphic processes have been considered by applying alternative models: fractional crystallization and diffusive modification [5,6].

Experiment and Calculation: We have measured chemical zoning profiles of several euhedral olivine grains (~500 μm in size) in LEW 85332 by an electron probe microanalyzer. Fractional crystallization and diffusive modification were assumed to distinguish igneous and metamorphic features and to constrain thermal history of LEW 85332. Detailed procedures of the two models are given in Jones [5] and Miyamoto et al. [6], respectively.

Results and Discussion: The observed zoning profiles of two representative (Fe-rich and Fe-poor) olivine grains are shown in Fig. 1, indicating that they are clearly zoned in FeO and CaO. The Fa component increases from the core to the rim in both olivines (Figs. 1a,c), whereas the CaO content increases in the Fe-rich olivine (Fig. 1b) and decreases in the Fe-poor olivine (Fig. 1d).

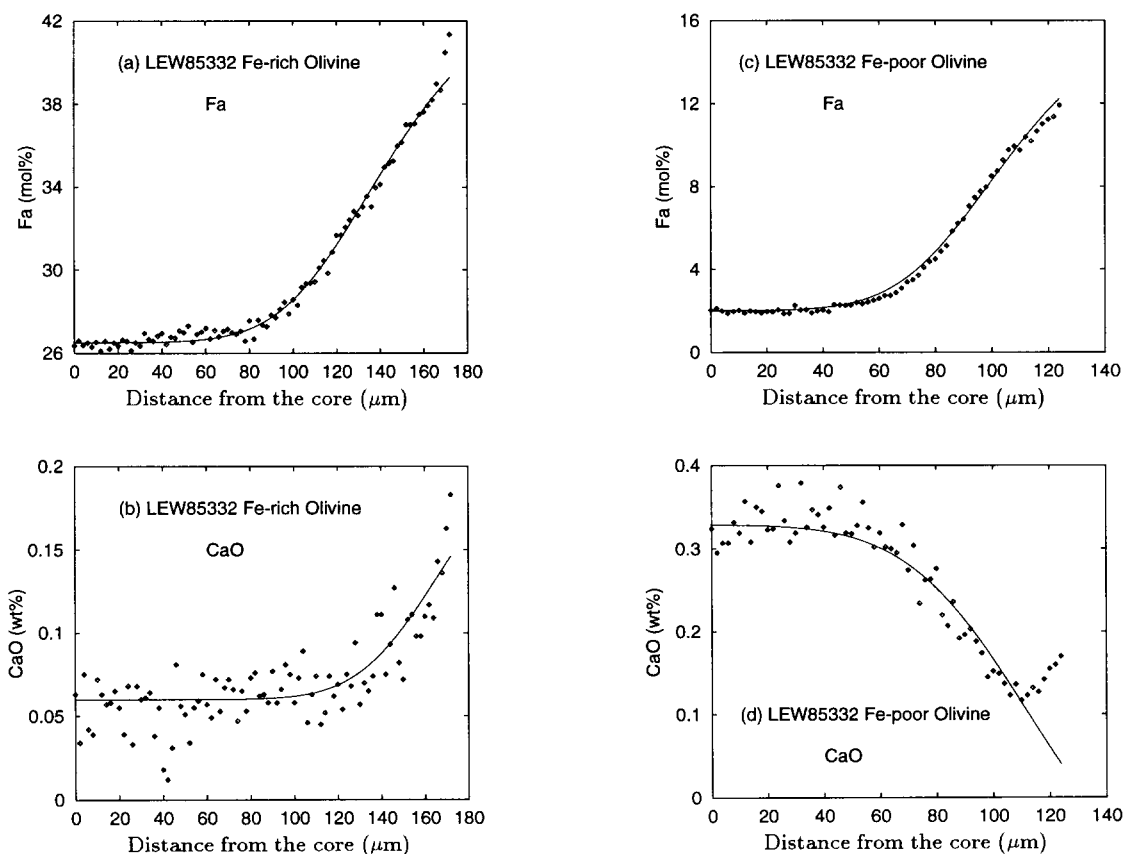


Fig. 1. Calculated (solid lines) and observed (diamonds) zoning profiles of (a, b) Fe-rich and (c, d) Fe-poor olivines in LEW 85332. Calculated profiles are obtained by a diffusive modification model cooling from 800° to 300°C. Cooling rates are of the order of 10°C/year. Disagreement near the rims is presumably due to subsequent modification.

Fractional crystallization: The calculated zoning profile of the CaO content in the Fe-rich olivine grain agrees with the observed one, whereas we obtained poor agreement for the atomic FeO/MgO ratio. We also obtained disagreement for the atomic FeO/MgO ratio of the Fe-poor olivine grain. It was impossible to reproduce the observed zoning profile of the Fe-poor olivine grain, because the value of distribution coefficient for CaO is <1.0 , i.e., the CaO content should increase toward the rim (Fig. 1d).

Diffusive modification: In order to consider various metamorphic conditions, calculations of chemical zoning profiles and cooling rates were performed in four different temperature ranges (1500–1000°C, 1200–700°C, 800–300°C, and 500–100°C). The calculated zoning profiles are in good agreement with the observed ones for both olivines except

near the rims (Fig. 1). The disagreement near the rims is thought to be due to subsequent modification that we do not take into account in the present study. For both olivine grains, we also obtained similar cooling rates ($\sim 10^\circ\text{C}/\text{year}$) between the Fa component and the CaO content in the temperature range of 800–300°C. The observed profiles can be interpreted to have been produced by atomic diffusion.

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